

**Course Title:** Radiological Control Technician  
**Module Title:** ALARA  
**Module Number:** 1.10

**Objectives:**

- 1.10.01 Describe the assumptions on which the current ALARA philosophy is based.
- 1.10.02 Identify the ALARA philosophy for collective personnel exposure and individual exposure.
- 1.10.03 Identify the scope of an effective radiological ALARA program.
- 1.10.04 Identify the purposes for conducting pre-job and/or post-job ALARA reviews.
- 1.10.05 Identify RCT responsibilities for ALARA implementation.

**References:**

- 1. NCRP Report No. 91 (1987) "Recommendations on Limits for Exposure to Ionizing Radiation"
- 2. U.S. Department of Energy, DOE-STD-1098-99, "Radiological Control Standard"
- 3. 10 CFR Part 835 (1998), "Occupational Radiation Protection"
- 4. ICRP Publication 37 "Cost-Benefit Analysis in the Optimization of Radiation Protection"

**Instructional Aids:**

- 1. Overheads
- 2. Overhead projector/screen
- 3. Chalkboard/whiteboard
- 4. Lessons learned

**I. MODULE INTRODUCTION****A. Self-Introduction**

1. Name
2. Phone Number
3. Background
4. Emergency procedure review

**B. Motivation**

All personnel at a facility must be committed to ALARA. The RCT can play a major role in establishing and maintaining that commitment.

**C. Overview of Lesson**

1. ALARA Philosophy
2. Objectives of ALARA Programs
3. ALARA Concerns
4. Collective Dose Philosophy
5. Scope of ALARA Program
6. ALARA Reviews
7. RCT Responsibilities

**D. Introduce Objectives**

O.H.: Objectives

**II. MODULE OUTLINE****A. ALARA Philosophy**

1. The cautious assumption that a proportional relationship exists between dose and effect for all doses (non-threshold concept) is the basis for ALARA. There may be some risk associated with any dose.
2. The effects of low-level doses over extended periods of time are not definitively characterized and the risk is difficult to quantify.

Objective 1.10.01

3. Studies of atomic bomb survivors and individuals involved in Nuclear incidents show the relationship between dose and effects is well known only at high doses.
4. The benefit of completing a task must be compared to the risk of the exposure received.

B. Objectives of ALARA Programs

1. There should not be any occupational exposure of workers to ionizing radiation without the expectation of an overall benefit from the activity causing the exposure.
2. Personal radiation exposure shall be maintained As-Low-As-Reasonably Achievable (ALARA).
3. Radiation exposure of the work force and public shall be controlled such that radiation exposures are well below regulatory limits and that there is no radiation exposure without commensurate benefit.

C. ALARA Concerns

1. Implementation of ALARA concepts should be carried out through all phases of a facilities lifetime.
2. ALARA Program concerns include:
  - a. Engineering features
    - 1) Discharge of radioactive liquid to the environment
    - 2) Control of contamination
    - 3) Efficiency of maintenance, decontamination and operations should be maximized
    - 4) Components should be selected to minimize the buildup of radioactivity
    - 5) Support facilities should be provided for donning and removal of protective clothing and for personnel monitoring
    - 6) Shielding requirements
    - 7) Ergonomics consideration
    - 8) Access control designed for hazard level

- 9) Surfaces that can be decontaminated or removed
- 10) Equipment that can be decontaminated
- b. Area arrangement
  - 1) Traffic patterns to allow access yet prevent unnecessary exposure
  - 2) Equipment separation
  - 3) Valve locations
  - 4) Component laydown/storage areas
- c. Operations
  - 1) Inspection tour - access, mirrors, visibility
  - 2) Inservice Inspections - use of remote control equipment, TV, Snap on insulation, platforms, etc.
  - 3) Remote readout instrumentation
  - 4) Remote valve/equipment operators
  - 5) Sampling stations, piping, valving, hoods, sinks
- d. Maintenance needs
  - 1) Adequate lighting, electric outlets, other utilities
  - 2) Removal and storage areas for insulation/shrouding
  - 3) Relocation of components to low dose areas
  - 4) Workspace for maintenance personnel
  - 5) Lifting equipment
  - 6) Conditions that could cause or promote the spread of contamination, such as a leaking roof or piping need to be identified and corrected on a priority basis.

- e. Radiological control needs
  - 1) Access control
  - 2) Shielding adequacy and access plugs
  - 3) Temporary shielding and support structures
  - 4) Adequate ventilation
  - 5) Breathing air
  - 6) Contamination control - drip pans, curbs, drains, and routing
  - 7) Decontamination facilities
  - 8) Radiation monitoring equipment
  - 9) Communications

D. Collective Dose Philosophy

Objective 1.10.02

- 1. Control of the collective dose to the work force.
- 2. Collective dose is defined as the total individual doses in a group or a population.
- 3. Spreading dose among more workers versus higher individual exposures for fewer workers is an ALARA issue.
  - a. Spreading dose
    - 1) The linear model states that the less exposure a worker receive the less chance they will receive harmful biological effects.
    - 2. Lower collective dose is a good indicator of an effective ALARA Program
  - b. Higher Individual Exposure
    - 1) Exposure to fewer individuals means that the risk to the rest of the work force has been minimized.
    - 2) Merely controlling maximum dose to individuals is not sufficient, collective dose must be controlled as well.

<ol style="list-style-type: none"> <li>4. Reducing radiological risks should not result in higher risks for other hazards.</li> <li>5. Reduction in radiological risk should be reasonably achievable based on the current state of technology, economic factors, and social conditions</li> </ol>	
<p>E. Scope of ALARA Program</p>	<p>Objective 1.10.03</p>
<ol style="list-style-type: none"> <li>1. Establish a program to maintain exposures ALARA.</li> <li>2. Design and modify facilities and select equipment with ALARA concepts integrated into the processes.</li> <li>3. Establish radiological control programs, plans and procedures.</li> <li>4. Make available equipment, instrumentation and facilities necessary for ALARA program implementation.</li> <li>5. Train facility workers and management as well as radiological control personnel in ALARA programs and reduction techniques.</li> <li>6. Applies equally to the reduction of external and internal exposure.</li> <li>7. The ALARA program must be incorporated in everyday, routine functions as well as non-routine, higher risk tasks.</li> <li>8. The involvement and commitment of all facility personnel, not just radiological control personnel, is necessary to achieve the reduction of external and internal exposure.</li> <li>9. To justify activities that could result in exposure to ionizing radiation, the following conditions should be satisfied:               <ol style="list-style-type: none"> <li>a. The risks associated with projected radiation exposures should be small when compared to the benefit derived.</li> <li>b. Further reduction in projected exposure is evaluated against the effort required to accomplish such reduction and is not reasonable</li> <li>c. The risks from occupational exposure or to the public should not exceed everyday or accepted risks.</li> </ol> </li> </ol>	

10. Ownership - each individual involved in radiological work must demonstrate responsibility and accountability through an informed, disciplined and cautious attitude toward radiation and radioactivity.
  - a. Management responsibilities:
    - 1) Design and implement ALARA program
    - 2) Provide resources such as tools, equipment, adequate personnel
    - 3) Create and support ALARA Review Committee
    - 4) Approve ALARA goals
    - 5) Design and implement worker training
  - b. Radiological Control Technician Responsibilities:
    - 1) Perform the functions of assisting and guiding workers in the radiological aspects of the job
    - 2) Knowledge of conditions at the work site
    - 3) Knowledge of work activities to be performed
    - 4) Identification of protective clothing and equipment requirements
    - 5) Identification of dose reduction techniques
    - 6) During work conduct, maintaining awareness of conditions
    - 7) Correction of worker mistakes
    - 8) Response to abnormal events
  - c. ALARA "group" - including facility/RC supervision/management:
    - 1) Evaluate worker suggestions and provide feedback in a timely manner
    - 2) Participate in pre-and post-work meetings
    - 3) Keep abreast of ALARA techniques pertinent to operations on site

- 4) Track facility performance in comparison to stated goals

## F. ALARA Reviews

### 1. Pre-job ALARA Reviews

Objective 1.10.04

- a. For every task involving radiological work, sufficient radiation protection controls should be specified in procedures and work plans to define and meet requirements.
- b. Applicable ALARA practices shall be factored into the plans and procedures for each task or type of task. The practices shall be communicated to the workers in ways that ensure that the employee is able to maintain their exposure ALARA.
- c. Proposed ALARA protective measures shall be evaluated to ensure the costs are justified.

### 2. Pre-Job Briefing

- a. Pre-job briefings are held with employees who will be involved in work activities involving unusual radiological conditions.
- b. Identify effective dose reduction measures.
- c. RC needs are communicated to workers. Worker needs are communicated to RC.
- d. Procedures are verified.
- e. Worker qualifications are verified.
- f. Emergency procedures are discussed.
- g. At the end of the meeting, everyone should know what is expected of them, how to do it, and the conditions under which it is to be done.
- h. ALARA pre-job briefing checklists
  - 1) Scope of work to be performed
  - 2) Radiological conditions of the workplace
  - 3) Procedural and RWP requirements



- 4) Special radiological control requirements
- 5) Radiologically limiting conditions, such as contamination or radiation levels that may void the RWP
- 6) Radiological Control Hold Points
- 7) Communications and coordination with other groups
- 8) Provisions for housekeeping and final cleanup
- 9) Emergency response provisions

### 3. Post-Job ALARA Reviews

- a. Jobs determined to require a ALARA review shall undergo a post-job review to ensure the overall effectiveness of job planning and implementation.
- b. Unusual exposure events are investigated to determine the root cause. Recommendations are made and corrective actions are then taken to prevent future reoccurrences of these events.

### 4. Post-Job Debriefing

- a. The opportunity to critique the work performance.
- b. Although, they will not affect the dose already received for a particular job, they can be effective in reducing the doses received the next time that job is performed.
- c. Information discussed at post-work meetings include discussions of what went wrong and what could have been done differently to reduce the exposures received.
- d. Post-work meeting rely heavily on the input of each radiation worker for information on how best to reduce exposure the next time that job is performed.
- e. Typical questions asked could include:
  - 1) Were there any problems performing the job in accord with the procedure?

- 2) Did you have the tools and equipment needed to perform the work? Could special tools ease the job?
- 3) Were there any unexpected conditions noted during the work? Could these conditions have been anticipated?
- 4) Were there any unexpected delays in the performance of the job? What was the cause of the delay?
- 5) Was temporary shielding used? Could the use of temporary shielding reduce exposures received for this job?

#### G. Radiological Control Technicians

1. The responsibilities of the Radiological Control Technician:
  - a. Pre-job ALARA reviews
  - b. Pre-job briefings
  - c. Radiation hold points identified
  - d. Tool and equipment requirements/need for special tools
    - 1) Pre-fabrication of temporary shielding
    - 2) Removal of component to low dose areas
    - 3) Previous job evolutions, previous survey conditions
  - f. Area Set-up
    - 1) Access to and from work area
    - 2) Service lines available - air, electric, ventilation, lighting
    - 3) Staging areas - low radiation areas, tool preparation and personnel waiting areas
    - 4) Communications - equipment, lines, TV monitoring

Objective 1.10.05

- 5) Radiological controls - anticipation of conditions during job with identification of controls required, surveys completed, high and low dose areas identified, contamination control requirements, airborne
- g. Worker preparation
  - 1) Experienced workers
  - 2) Specialized training - mock ups, photographs, rehearsals, etc.
  - 3) Briefings - conditions, needs of RC personnel, what to expect, abnormal conditions
  - 4) Pre-work check off packages
- h. Conduct of the job
  - 1) The technician is tasked with assisting other workers in maintaining their exposures ALARA.
  - 2) The technician can not lose sight of his own exposure reduction needs.
  - 3) The RCT is expected to observe the worker to ensure that the radiological control requirements pertinent to the hazards present are taken and followed properly.
  - 4) If the technician notices the worker not following good radiological work practices, on the spot corrections should be made.
  - 5) Stop work authority is granted to all employees and all radiological control personnel should exercise this authority when:
    - a) Inadequate radiological control
    - b) Radiological controls not being implemented
    - c) Radiological controls hold point not being satisfied

**III. SUMMARY****A. Review major topics**

1. ALARA Philosophy
2. Objectives of ALARA Programs
3. ALARA Concerns
4. Collective Dose Philosophy
5. Scope of ALARA Program
6. ALARA Reviews
7. RCT Responsibilities

**B. Review learning objectives****IV. EVALUATION**

Evaluation should consist of a written examination comprised of multiple choice questions. 80% should be the minimum passing criteria for the examination.